Proceedings of the Third International Conference on Electronics Communication and Aerospace Technology [ICECA 2019]
IEEE Conference Record # 45616; IEEE Xplore ISBN: 978-1-7281-0167-5

ProTecht – Implementation of an IoT based 3 –Way Women Safety Device

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Abstract— **In this paper, an IoT based women safety device is proposed and implemented for effective self-alert and protection. The proposed device is a three-way safety module for it provides self-defense, evidence recording and tracking information.** Due to increase in the rate of crimes against women, today's age safety of women is a major concern. For self-defence the device produces shock to the attacker through a nerve stimulator and rings a buzzer on pressing a button. It also allows to record evidence via a video camera which gets activated through the button and stores the footage in the Raspberry Pi. The prototype also consists of a GSM and GPS module which is activated by voice command through an Android Application. When the user will say the words "emergency" in his mobile application the device will send SMS alert containing the location of the user and auto dial the pre-set emergency contact number. A microphone and speaker are connected with the GSM module through which the user can hear and speak with the contacted person. Hardware used are Raspberry Pi 3 b+, GSM module, GPS module, relay module, buzzer and nerve stimulator.

Keywords—IoT, Raspberry Pi, safety device, GSM, GPS, self-defense, SMS, call alert, Android Application

I. INTRODUCTION

In the present era women are taking equal responsibilities in work area. They are maintaining work and home simultaneously which requires travelling and working odd shifts. Safety is a major issue which restricts women. For women to grow in their field of work or simply live their lives and feel free, safety has to be granted in all spheres. India is still trapped in the clutches of various patriarchal evils like molestations, assaults, and various crimes against women. These crimes may be committed by strangers, acquaintances or even family members. Rapes and sexual harassment cases have been report by women in workplace, public area, at homes, etc. In India such cases have increased by 83% from 2007 to 2016. The latest National Crime Records Bureau data reflects how incidents of rapes have gone up by 12-15% while other crimes have risen by 3-5%. At 25% the conviction rate of crimes against women in 2016 was lowest since 2007. This is due to various reasons such as lack of evidence, withdrawing case for personal safety issues, societal norms etc.

The government has taken measures to reduce the crimes through laws and legislations to assure safety in workplace, public places. Punishment for such crimes have been made more severe New laws have been established and modifications have been made to the existing ones but as seen from the statistical data the crime rates are still high. This requires a safety provision that will be able to make women defend themselves, keep them safe and secure and not feel helpless while alone in the street's workplaces or at home. In order to serve the purpose, we have developed a prototype of 3-Way Women Safety Device named 'ProTecht' which can be used in workplace, market area, and various public places. It provides features for self-defence and alerting the user's emergency contacts through location information and auto-dialled call. It also has a video camera to record evidence.

In a device named SIREN which is disguised as ring, it helps users stay safe by emitting a loud and piercing sound to confuse and distract attackers. The loudness of the sound is over 110 decibels and can be heard from 50 feet distance. Users simply twist the top of the ring to the left, approximately 60 degrees, to emit the loud sound

In ref. [1] ATHENNA creates a simple way for women to get help. Roughly the size of a half dollar coin, Athena activates a loud alarm when users press a button.

In a device named ILA SECURITY, the co-founders of this system have designed 3 personal alarms that can shock and disorient potential attackers. The drawbacks of this system are that it does not notify anyone regarding the location of the victim and no evidence is collected against the culprit.

Devices like 'One Touch Alarm System for women's safety using GSM' consists of a microcontroller, GSM module, GPS modules. When the system is activated, it tracks the location of the women using GPS (Global Positioning System) and sends emergency messages using GSM, i.e. Global System for Mobile Communication, to selected contacts and the police control room. Emergency button trigger is used to activate the device [2]. In 'GPS and GSM Based Self Defence System for Women Safety' [3], an additional speech circuit is provided to alert people around,

along with the provisions in the above-mentioned design [2].

With addition to these various applications have also been developed such as '*VithU'*. The VithU application is an initiative taken by a television channel, Channel [V], for the emergency cases. With only 2 clicks of the power button, anybody facing danger can send out an SOS message to their guardian [4]. *'Jivi 2010'* an inbuilt application of JIVI smartphones enables users to send alert messages and SOS messages to designated receivers or guardians with the location of the victim [5].

Many wearable devices have been developed that incorporates GPS and GSM technologies with various sensors and microcontrollers such as *'Suraksha'* [6] and *'Amrita personal safety system (APSS)'* [7] which are simple and easy to carry devices with basic approach to intimidate instant location and a distress message to the cops and registered number.

An Arduino based design has been developed in which along with tracking features a camera has been attached to record evidence [8]. Also, Android application have been developed which makes use of the GPS, feature present on the mobile phones to send locations and alert messages by voice command and clicking button in the apps [9][10].

Drawbacks:

- No provision for data storage.
- Features of the device will be limited in number.

Products have been developed in cloud technology making devices more efficient user friendly and less implementation cost. It aims to provide low cost IoT based solutions for women safety which includes image capturing of culprit, making alert call via cloud (Twilio) to family, police station alerting woman is in danger locating the position of women under danger [11].

An Arduino based electronic system for women which comprises of sensors such as temperature LM35, flex sensor, MEMS accelerometer, pulse rate sensor, sound sensor which senses the body parameters like heart rate, change in body temperature, the movement of the user by flex sensor, MEMS accelerometer and the voice of the victim is sensed by sound sensor. When the sensors cross the threshold limit, the device is activated and it traces the location of the victim using the GPS module. By using the GSM module, the victim's location is sent to the registered contact number [12].

A Raspberry Pi-based design has been proposed which, along with alerting and self-defence mechanisms, provides live video streaming using webcam [13].

One of the existing works is based on ARM controller and Android application in which both the device and the smart phone are synchronized using Bluetooth, hence both can be triggered independently. For further investigation, we can record audio and can send an alert call and message to the pre-set contacts with the current location every 2 minutes and it can be tracked live using our application. Hidden camera detector is also a distinct feature using which we can ensure our privacy [14].

From the existing works, we can infer the following as requirements for a safety device:

- Providing mechanisms for self-defence
- Evidence recording of the scene
- Location information of the user
- User friendly
- Data storage for improving performance
- Cost efficient
- Portable
- High level of security
- Less time for processing

Based on these inferences, a prototype for ensuring women's safety has been developed which will help a woman stay safe and protect herself. It a simple design which includes all necessary mechanisms required along with an Android Application and a Web Page.

The organisation of the paper is discussed here. Section II explains the methodology of the system and the workflow along with the algorithm of different parts and circuit. It also gives details of the hardware and software used. Section III discusses the results. Section IV concluded the paper and gives the future scope of this work.

II. METHODOLOGY

This model serves as an alerting device as well as for self-defense. In this Project, we use GSM which is capable of sending SMS to the mobile in real time and also for calling purposes. GPS is connected to the Raspberry Pi to show the exact latitude and longitude coordinates of the user location. A switch is connected here to activate the buzzer, video camera and nerve stimulator when it is pressed. An Android application is used to activate SMS and call using voice command. Finally, the application of IoT technology here is to upload all the current status from the microcontroller to server for the storage and for global viewing for all accessible user. The GSM module, which an attached mic and speaker, allows two-way communication with the pre-set numbers and the user can speak to the person on the other end of the call about the situation. Fig. 1 depicts the working of the proposed prototype. Fig. 2 shows the input out connections of the device connected to Raspberry Pi.

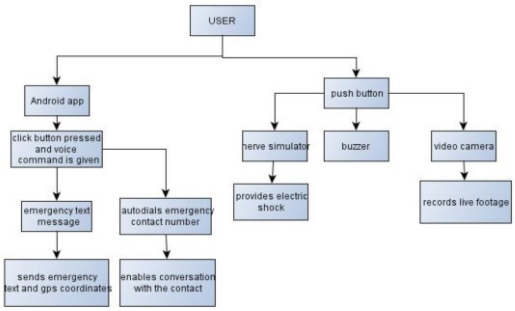

Fig. 1 Workflow of the 3-way Women Safety Device

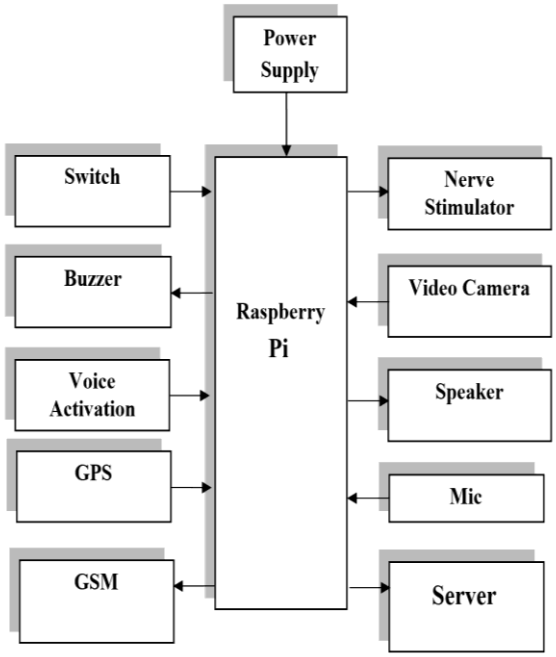

Fig. 2 Input/ Output Connections to the Raspberry Pi

A. Hardware Specifications

The specifications of the hardware used in this project are given below:

Raspberry Pi 3 B+ is a single board computer with Quad core 64-bit processor clocked at 1.4GHz, 1GB LPDDR2 SRAM, Dual-band 2.4GHz and 5GHz wireless LAN, Bluetooth 4.2 / BLE, Higher speed Ethernet up to 300Mbps and Power-over-Ethernet capability.

Fig. 3 Raspberry Pi 3 B+ [15]

Global positioning system (GPS) module is very adaptable and can be found in practically any industry division. The utilizations of GPS are:

1. Location - deciding a position
2. Navigation - getting starting with one area then onto the next
3. Tracking - checking an item or individual movement
4. Mapping - making maps of the world
5. Timing - bringing accurate timings to the world

The NMEA format used for our project is the Recommended Minimum Specific GPS/Transit data, i.e. $GPRMC.

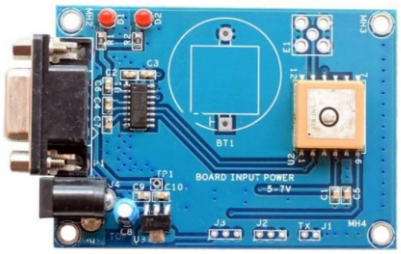

Fig. 4 GPS Module [16]

GSM/GPRS module is utilized to set up communication between a computer and a GSM-GPRS framework. Global System for Mobile communication (GSM) is a design utilized for mobile communication in a

large portion of the nations. Global Packet Radio Service (GPRS) is an augmentation of GSM that empowers higher information transmission rate. GSM/GPRS module comprises of a GSM/GPRS modem amassed together with power supply circuit and communication interfaces (like RS-232, USB, and so on) for the computer. The model used for designing this prototype comes with an attached mic and speaker.

Fig. 5 GSM Module with speaker and mic [17]

Camera is used to record the video evidence. Here, the video camera is attached to the Raspberry Pi via the USB port. On being activated, the recorded video is stored in the Raspberry Pi.

Fig. 6 Video Camera [18]

Relay module is a switch which is operated electrically. The electric current flowing through the coil in the relay creates a magnetic field. This attracts a lever and changes the switch contacts. Here, it is being used to open and close the connection of the nerve simulator.

Fig. 7 Relay Module [19]

Transformer is used to convert 240V AC supply to 12V AC supply which along with capacitors and bridge rectifiers stabilizes the AC current and converts it into 12V DC supply.

Fig. 8 Step-down Transformer [20]

Nerve stimulator is used to generate electric pulses. It is widely used for medical purposes. In this project, it is used to give electric shocks. The specifications of the nerve stimulator used in our design is as follows: -

- input voltage is 5v
- Output voltage: 5-15v
- Frequency range: 0.1 to 99 Hz.
- Resolution: 0.01mA
- Pulse duration: 0.1ms.

Fig. 9 Nerve Stimulator

B. Software Specifications

The software details of the project are given below:

VNC viewer works by transmitting the majority of your console and mouse developments to a customer computer. Individuals can utilize VNC to remotely get to records on specific computers in a wide scope of circumstances. It is used to control the Raspberry Pi from another computer.

IDLE is an integrated development environment (IDE) for editing and running Python 2.x or Python 3 programs. IDLE was designed specifically for use with Python. IDLE has multiple features for to assist develop Python programs including powerful syntax highlighting.

Android Application is developed using the official integrated development environment (IDE) for Android application development. It is based on the IntelliJ IDEA, which is a Java integrated software development environment and it incorporates code editing and developer tools.

Web Server is used in this project for IoT application. Here, the server is storing the information sent from the Android application, which can be accessed by the Raspberry Pi, and the location information received from the GPS. A webpage has been created using PHP and HTML language which displays the GPS location, date and time of data logging.

C. Aglorithm

The main algorithm for the working of the designed prototype is shown is Fig. 10. The Raspberry Pi receives a signal when the switch is pressed and then it sends signals to activate the camera, buzzer and nerve stimulator through relay module. Next, it checks if any voice command has been received by obtaining information from the server. If this condition holds true then a signal is sent to the GSM module for SMS and auto-dialled call to ICE. Then the status in server is returned to the initial state.

Next, we discuss the algorithm used to extract information received from the GPS module. After defining UART for serial communication and establishing connection, the Raspberry Pi starts reading the input sent from the GPS module. The format used here is $GPRMC. After receiving a frame of information, the Raspberry Pi checks for the $GPRMC format. It then extracts the latitude and longitude value using the knowledge of position of them in the GPRMC format. This information is stored in the server from which it can be accessed and sent using SMS through GSM module and also viewed in the webpage.

For configuring the GSM module and Raspberry Pi interface, serial communication is established by defining UART and by using AT commands. The AT commands used are as follows:
AT: Command to test the condition of the modem and initiate transmission.
AT+CMGF=1: Command to enable Text Mode.
AT+CMGS= [Mobile Number]: Command to send SMS number mentioned in command.
ATD Mobile Number]: Command to call the number mentioned in command.

Android Application and Webpage: In this project, an Android application is used for giving a voice command that enables the user to send emergency text message, GPS coordinates and autodials to a pre-set ICE contact number. The homepage of the application has a simple user interface which consists of a “click me” button and a three-dotted menu bar. Voice input is given by clicking the button and saying the pre assigned keyword “EMERGENCY” and google speech-to-text API converts it to text. When the command is given, a list of words predicted using google voice assistant is displayed in the interface. If the word command matches the keyword then the status in updated the server on establishing connection. The Raspberry Pi reads this status and enables the GSM and GPS modules to send text message with coordinates and call the saved emergency contact number. A webpage is developed which displays the GPS coordinates along with the logging date and time.

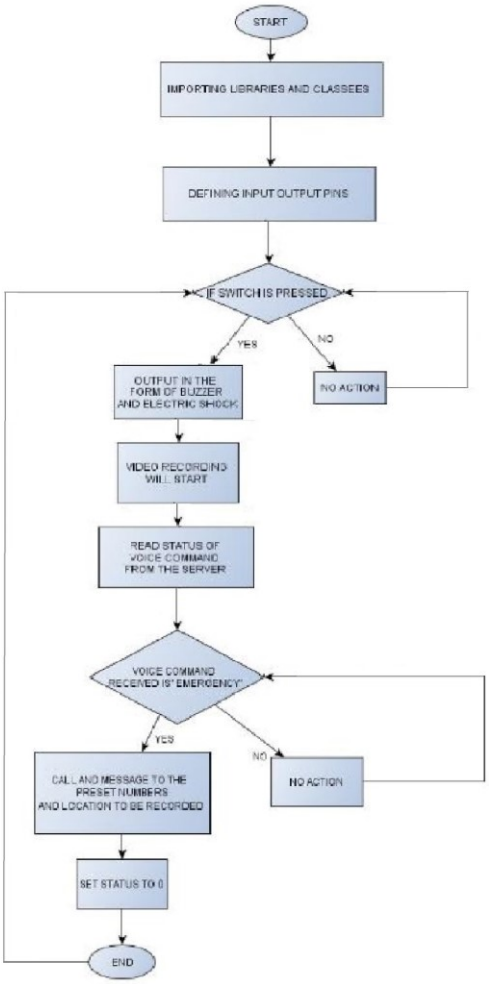

Fig. 10 Algorithm for the device

D. Circuit Diagram and Explanation

The circuit diagram is shown in Fig. 11. The transformer converts the 240V AC supply to 12V AC Supply. The bridge rectifier and the 1000µF Capacitor converts the AC supply to DC supply by smoothening the current. This supply is given to the GPS, GSM and reply module. Relay module is used for activating the nerve simulator. The microphone and the speaker is connected to the respective ports of the GSM. The GSM module is connected to the GPIO14 pin and the GPS module is connected to the GPIO15 pin of the Raspberry Pi. When the user presses the push button which is connected to the GPIO26 pin of the Raspberry Pi, the buzzer at the GPIO21 pin of the Raspberry Pi goes off and the relay module becomes normally closed and activates the nerve simulator. The camera, which is connected to the USB Port of the Raspberry Pi, starts recording the video and stores it in the Raspberry Pi.

The user uses the Android application for the saying the voice activation code ‘Emergency’ and the google speech to text API converts it to text. After the detection, using the GSM, SMS is sent to the ICE contacts stating that the person is in danger with a geotag which when opened shows the location in Google Maps using the GPS. A call is auto-

dialled to the police for the victim to communicate using the GSM, microphone and speaker.

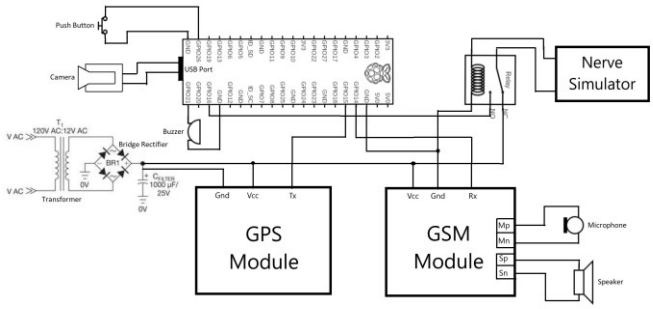

Fig. 11 Circuit Diagram

III. RESULTS AND DISCUSSION

Fig. 12 shows the hardware setup of the proposed design of the safety device. As shown in the diagram, hardware consists of transformer (1), push button(2), Raspberry Pi(3), buzzer(4), video camera(5), GPS module(6), GSM module(7), relay module(8) and nerve simulator(9).

On pressing the button, the relay module receives an input signal. The nerve stimulator connected to the relay module produces an electric shock, as shown in Fig. 13. Along with this, the buzzer goes off giving a loud sound. The video camera starts recording.

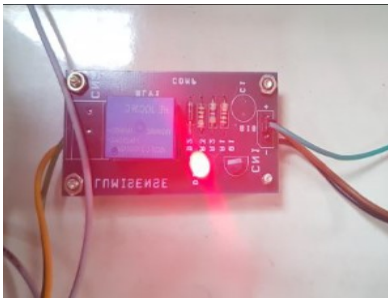

Fig. 13 Relay Module on receiving input signal

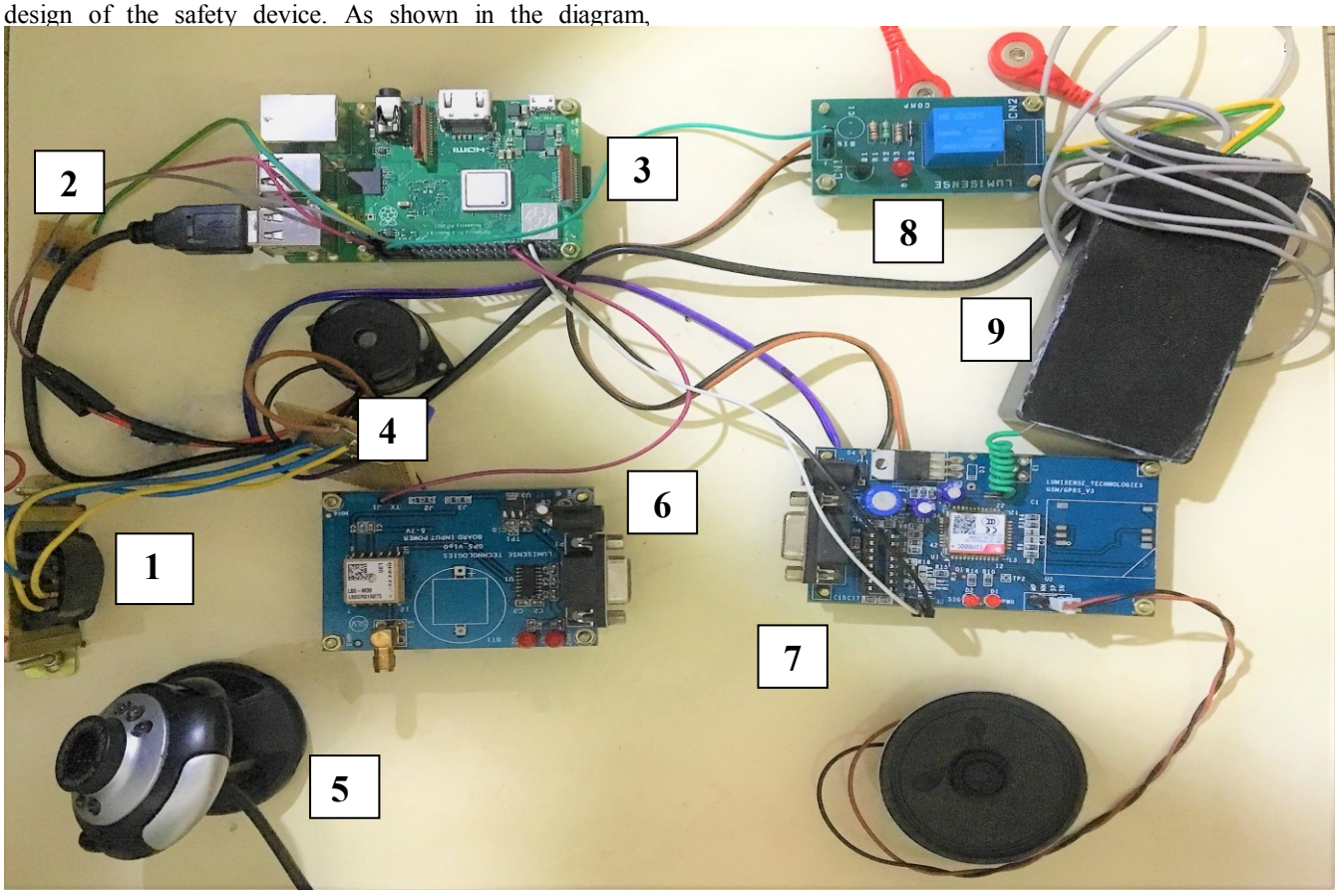

Fig. 12 Hardware setup of the 3-Way Women Safety Device

The Android application interface is shown in Fig. 14 On giving the voice command “EMERGENCY” status is updated in the server. Fig. 16 shows the words predicted by the application using google voice assistant.

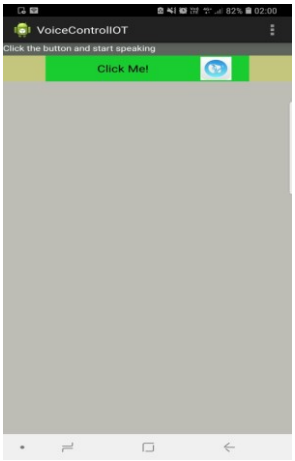

Fig. 14 Android application interface

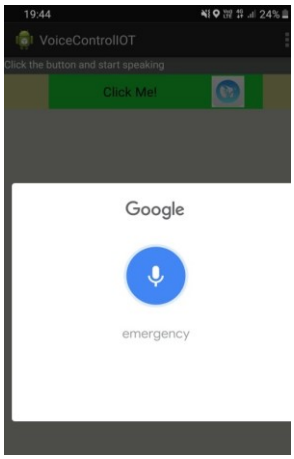

Fig. 15 “Emergency” command given to the application

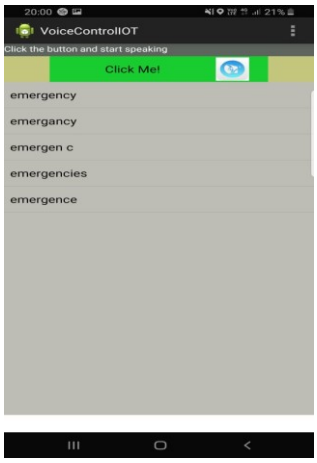

Fig. 16 Words predicted by google assistant

When a voice command “Emergency” is passed through the app, a call and message is sent to the pre-set number as shown in Fig. 17 and Fig. 18.

The latitude and longitude are logged into the server as shown in Fig. 19.

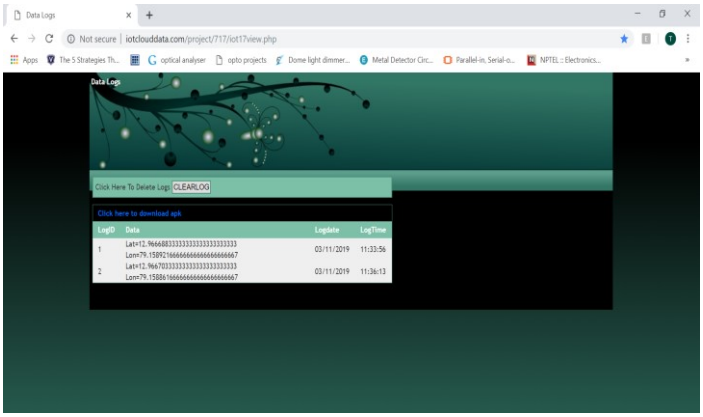

Fig. 19 Location details on webpage

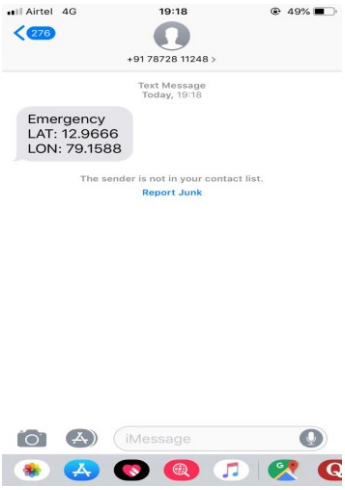

Fig. 17 Text message with location details

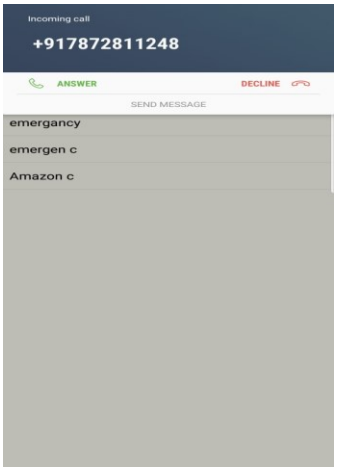

Fig. 18 Auto-dialled call to pre-set number

Our proposed design fulfills the three major aspects of Women's safety- self-defense, evidence recording, and tracking location. It is an all-in-one device. The existing devices solely providing self-defense mechanism or tracking information does not provide high level of security. It does not ensure completely safety of the user.

By using IoT technology, the data is recorded and can be used further. It also enables us to add multiple features to the device for improving security level. The Android application can be easily installed in any Android mobile phone. It is a user-friendly device and just requires the user to touch a button on screen and say the word "EMERGENCY".

IV. Conclusion and Future Scope

The IoT based 3-Way Women's Safety Device serves its purpose efficiently by providing self defence mechanism to the users along with tracking information and recording evidence features. When the switch is pressed the buzzer goes off immediately simultaneously activation nerve stimulator and video camera. When the user says the words "EMERGENCY" through the Android application, message and call is received by the saved emergency contacts along with the live location of the user. The response of the device is fast and it can help the user to stay safe in any place.

This prototype can be further developed further to make a wearable device. The design can be made more compact and lighter in weight so that it can be easily portable and user friendly. The Android application can be used to make the device more effective. It can have provisions to enter multiple contact details as per the user's requirements. Also, recorded evidence can be made accessible through the application. More defence features can be added which can be controlled by various monitoring system.

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